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INJURIOUS CONSTITUENTS OF
POTABLE SPIRITS. 33

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PRELIMINARY COMMUNICATION.

THE phenomena exhibited by the human subject when poisoned by the ordinary potable spirits are very varied, and are caused no doubt by complex conditions which may, however, be divided into two classes—viz., those that depend upon the individual and those that depend upon the composition and nature of the spirit drunk. It is to the latter that we have directed our attention. These differences in the phenomena produced by the alcoholic beverages ordinarily consumed are more marked in the initial stages of alcoholic poisoning. To put it in plain language, it is when a man begins to get drunk and when he begins to get sober that he is apt to find out the quality of the liquor which he has taken. In the intermediate stage between these two conditions—viz., that of deep drunkenness—it matters but little. As the ethylic alcohol is common to all potable spirits, changes other than quantitative in this substance cannot be the cause of what may perhaps best be termed the subsidiary effects (*Nebenwirkungen*) of acute or chronic alcoholism. The main points in which potable spirits differ *inter se* are with regard to their aldehyde, compound ether, higher alcohol (fusel oil), and certain volatile base contents. This communication is devoted to the question of the aldehyde contents of various potable spirits and liqueurs, and especially to one particular aldehyde—viz., *furfural*.

The source of furfural in the manufacture of whisky, and of beer to a less extent, is a class of substances known as pentosanes; these are present in, and derived from, the cellulose of the grain husks. Under the influence of heat in the presence of acids furfural is formed from them. The

substances which we have examined in this connexion are whisky fresh from the pot still and mature, brandy, gin, rum, various impure and cheap spirits used in the colonies—such, for instance, as “Cape smoke”—and also a number of Spanish, Portuguese, Chinese, and Japanese cheap alcoholic drinks. These substances all contain aldehydes and furfural in varying proportions, the latter substance in some cases (according to quantitative estimations made by Professor Hewitt) to the extent of 0.03 gramme per litre. The presence of furfural in, for instance, whisky can be easily demonstrated by taking a teaspoonful of whisky in a test tube, diluting with an equal volume of water, and adding a few drops of a sodium carbonate solution, and then a few drops of solution of aniline acetate. If the test tube be shaken up and allowed to stand a rose-pink colour will soon develop if furfural be present, and the deepness of the colour will be approximately proportional to the amount of this substance in the sample of whisky under experiment.

The experimental part of our work may be divided into two parts. We first endeavoured to ascertain the physiological action of furfural upon animals and man. In this connexion we made experiments upon cats, dogs, and rabbits and observations upon two men. By means of these experiments we found that doses of furfural of from 0.1 to 0.05 gramme injected subcutaneously caused paralysis of the voluntary muscles, and later clonic and tonic convulsions, probably due to asphyxia, with rapid and irregular breathing. An odd point about these symptoms was their transient nature; immediately after the injection of the drug the animal would fall down completely paralysed, its tongue and lips would become bluish, and its breathing sometimes very slow and convulsive and at other times irregular and rapid; it would then pass into a stage of clonic and tonic convulsions, in many cases it would vomit, and, finally, would begin to recover, being at first dazed, but rapidly becoming apparently normal. The whole cycle of symptoms would often be completed in from 20 minutes to half an hour. Sensation never seemed to be affected, the conjunctival reflex was always to be obtained, and when the voluntary muscles were paralysed strong reflex irritation (faradaic current) was generally responded to by changes in the respiratory rhythm. Smaller doses always caused symptoms of transient irritation, such as ataxia, tremors, and twitching, especially of the facial muscles. In the case of larger doses than 0.5 gramme death was produced from asphyxia due to paralysis of the respiratory muscles.

Almost identical symptoms were produced when the substance was given by the stomach mixed with milk or water, in doses of about 0.5 gramme in cats. The effect of the drug was less marked when given with milk and much more marked when administered upon an empty stomach. In the case of man 0.1 gramme of furfural was taken two hours after lunch by two men; the pulse and respiration were unaltered, but about half an hour afterwards pain (like neuralgia) was felt at the back of the neck and extending up to the occipital region, and a sensation of throbbing and pulsation in the vessels of the head. A dull headache ensued which in one case lasted for the rest of the day. Both in the case of man and in the cases of animals the urine gave a furfural reaction with aniline acetate after the administration of the drug.

The second series of experiments which we undertook were made to ascertain whether the removal of the furfural, or to speak more accurately the aldehydes from the potable spirits, produced any change in the symptoms of alcoholic poisoning. One of the differences, *inter alia*, between raw and matured spirit is the quantity of aldehydes which they contain, matured spirit containing a smaller quantity than is contained in the raw spirit. Up to the present the obtaining of an aldehyde-free spirit has been a matter of some difficulty; we were, however, able by the use of a method described fully elsewhere by Professor Hewitt to remove entirely the aldehydes from any given spirit.

The symptoms of alcoholic poisoning produced by equal doses of the spirit free from aldehydes and the spirit containing aldehydes were compared in the case of animals. The method adopted was to render an animal paralytic and anæsthetic with the potable spirit under observation before and after the removal of the aldehydes and to watch its recovery—i.e., its return to what was presumably its normal state. Speaking generally it was found that the return from what may be termed profound drunkenness in the cases of animals was more sudden and was accompanied by less secondary symptoms when aldehyde-free spirit had been given. In the case of the spirit containing aldehydes the animal during the transition stage was restless, wandering from one part of the laboratory to another, and seemed, generally speaking, remarkably uncomfortable. Even when the gross symptoms of alcoholic poisoning had passed off the animal did not behave normally for some time, refusing the food offered to it, and showing marked signs of bad temper.

These secondary phenomena were entirely absent in the case of the aldehyde-free spirit. The animal woke up and attempted to stand; if it could not, it went off to sleep again. When it was sober it appeared perfectly normal and if offered food took it.

The interest of these observations lies in the fact that these disagreeable symptoms, which seem analogous to those occurring in the human subject after too free potations, seem to be more referable to the aldehydes in the spirit, including furfural, than to the spirit itself or any higher alcohols. Fusel oil was present in the spirit both before and after distillation.

The aldehydes are pharmacologically active, their action depending, according to Loew, upon their combining with the amido groups (NH_2) of the proteid molecule; their antidote, or at least one of their antidotes, is ammonia, which forms with them an innocuous compound. This fact has a bearing upon the subject in hand, for the substances which have a reputation amongst alcoholics as "morning pick-me-ups" contain either ammonia or simple or substituted amido groups, or just those groups which are capable of neutralising aldehydes. If the residue which is left behind after distilling the spirits with phenyl hydrazine sodium sulphonate be treated by appropriate methods the aldehydes are liberated. It is to the pharmacological action of this distillation residue that we are at present directing our attention, and we hope to be able to publish our results with it shortly, as well as a more exhaustive account of those enumerated above, with the literature of the subject.



